(12) UK Patent Application (19) GB (11) 2 359 270 (13) A

(43) Date of A Publication 22.08.2001

(21) Application No 0101870.4

(22) Date of Filing 24.01.2001

(30) Priority Data
(31) 10002840 (32) 24.01.2000 (33) DE

(71) Applicant(s)
Wincor Nixdorf GmbH & Co. KG
(Incorporated in the Federal Republic of Germany)
Heinz-Nixdorf-Ring 1, 33106 Paderborn,
Federal Republic of Germany

(72) Inventor(s)
Ulrich Neumann
Jurgen Schluter

(74) Agent and/or Address for Service
Haseltine Lake & Co
Imperial House, 15-19 Kingsway, LONDON,
WC2B 6UD, United Kingdom

(51) INT CL[7]
B29C 44/42 33/40 44/10

(52) UK CL (Edition S)
B5A AD20 AD28 AD33 AT14P A1R314C3 A1R314C6
A2E8 A20T14

(56) Documents Cited
EP 0914919 A1 CA 001116364 A JP 080318542 A
JP 030051110 A US 4855094 A

(58) Field of Search
UK CL (Edition S) B5A AD20 AD28 AD29 AD33 ANA
ANC AT14B AT14P AT14U
INT CL[7] B29C 33/00 33/10 33/40 44/00 44/02 44/10
44/34 44/42 45/00 45/03 45/34 45/40 45/43 45/57
ONLINE: WPI, EPODOC, PAJ

(54) Abstract Title
Producing formed portions from foamable plastics material

(57) Producing formed portions from a foamable plastics melt, the plastics melt being filled into a pressurised forming cavity 34, the pressure being reduced after filling has taken place so that the plastics melt foams, and after the plastics melt has cooled, the formed portion is removed from the mould 10, wherein the gas pressure in the cavity 34 is kept constant during the filling of the cavity 34. The gas pressure may be kept at a constant value of 10 to 14 bar. A venting channel 24 may be arranged between the halves 11, 32 of the cavity 34 for the escape of gas. The formed portions may be operator panels (54 of figs 4 and 5) for automatic cash dispensers.

Fig. 2

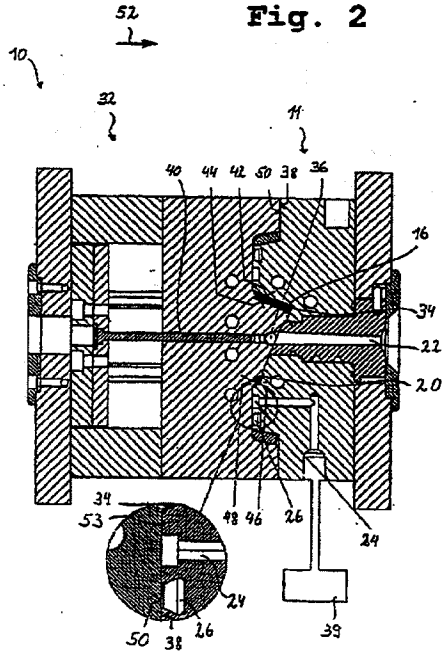

Fig. 3

GB 2 359 270 A

FIG. 1

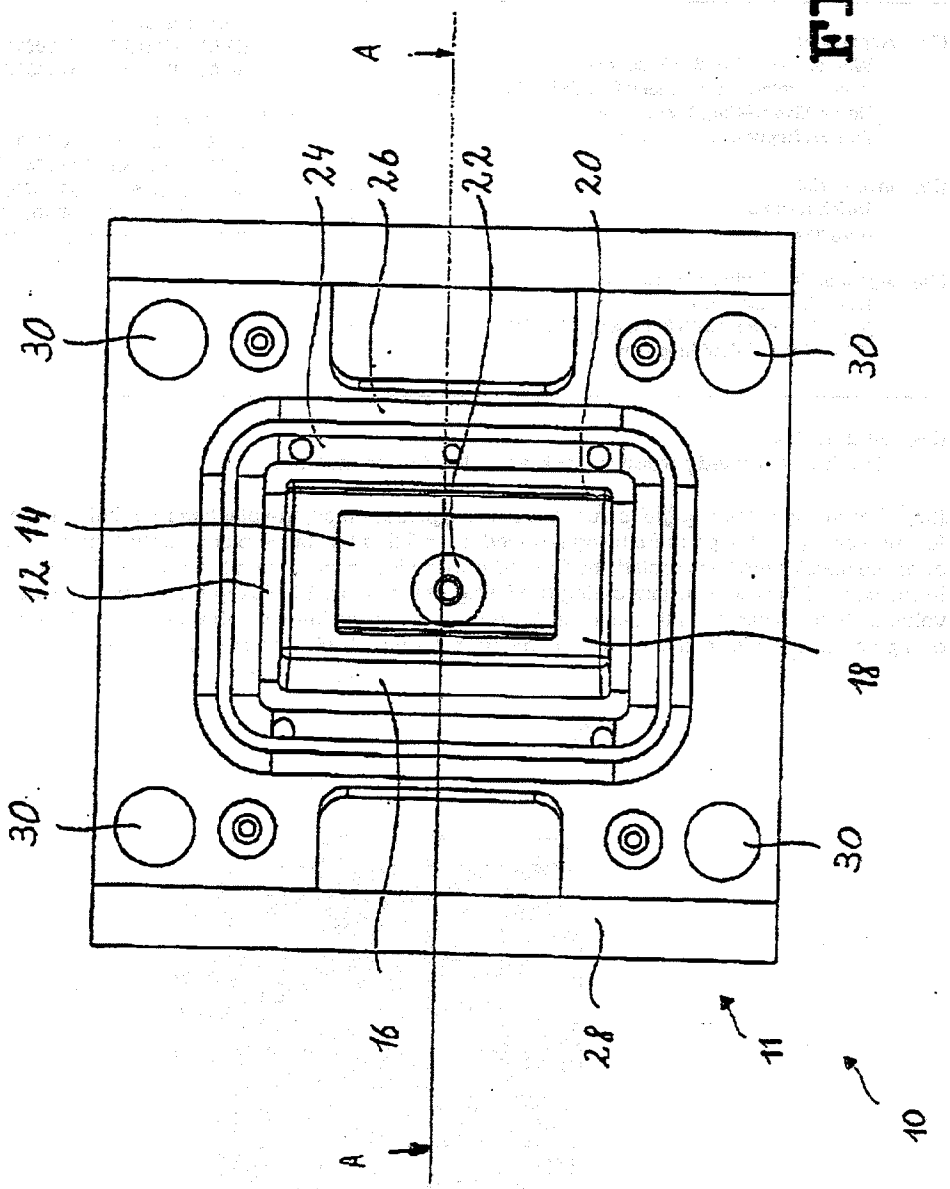

Fig. 2

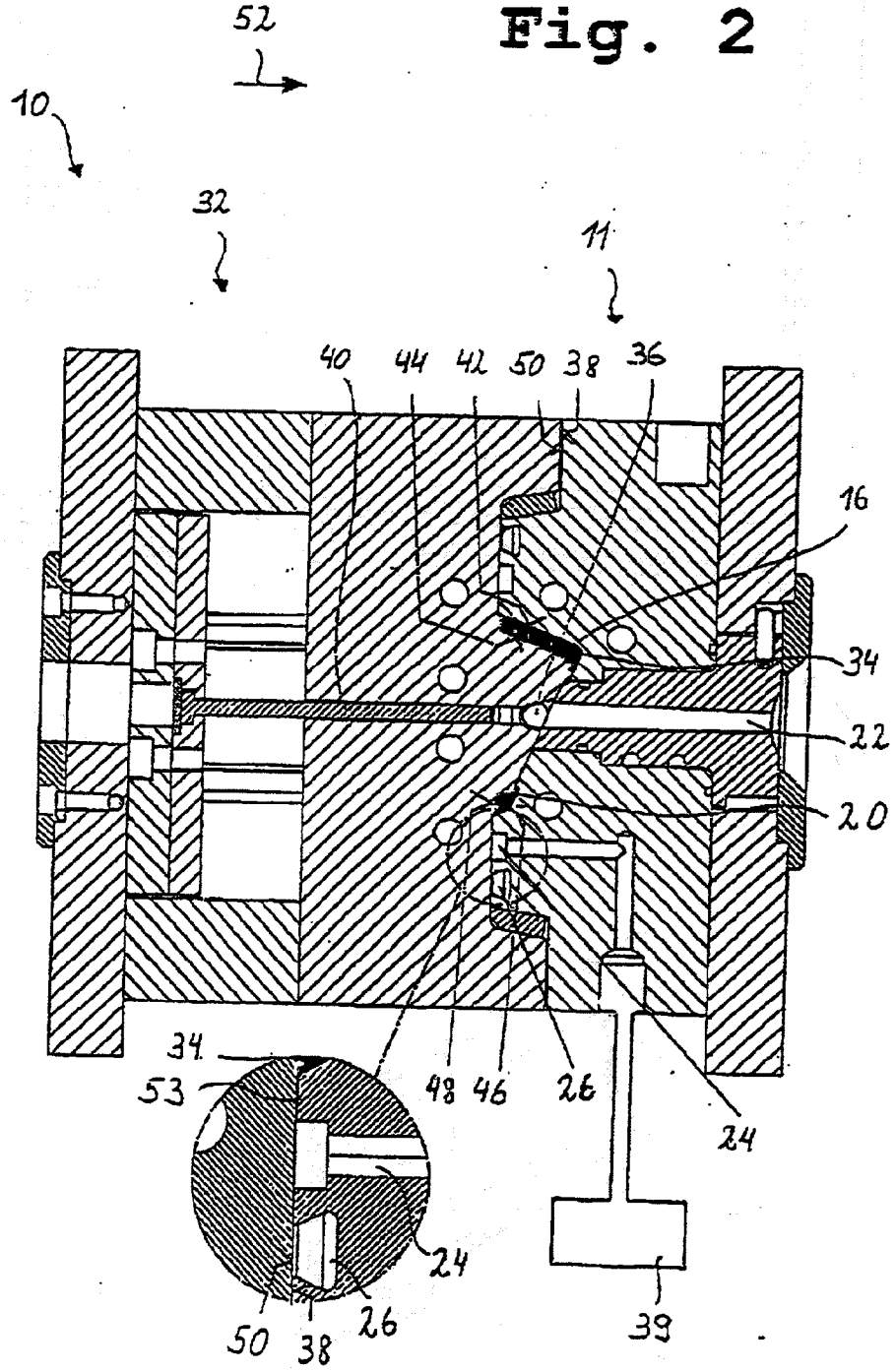
52
10
32
11
40
44
42
50
38
36
16
34
22
20
34
53
48
46
26
24
24
50
38
26
39

Fig. 3

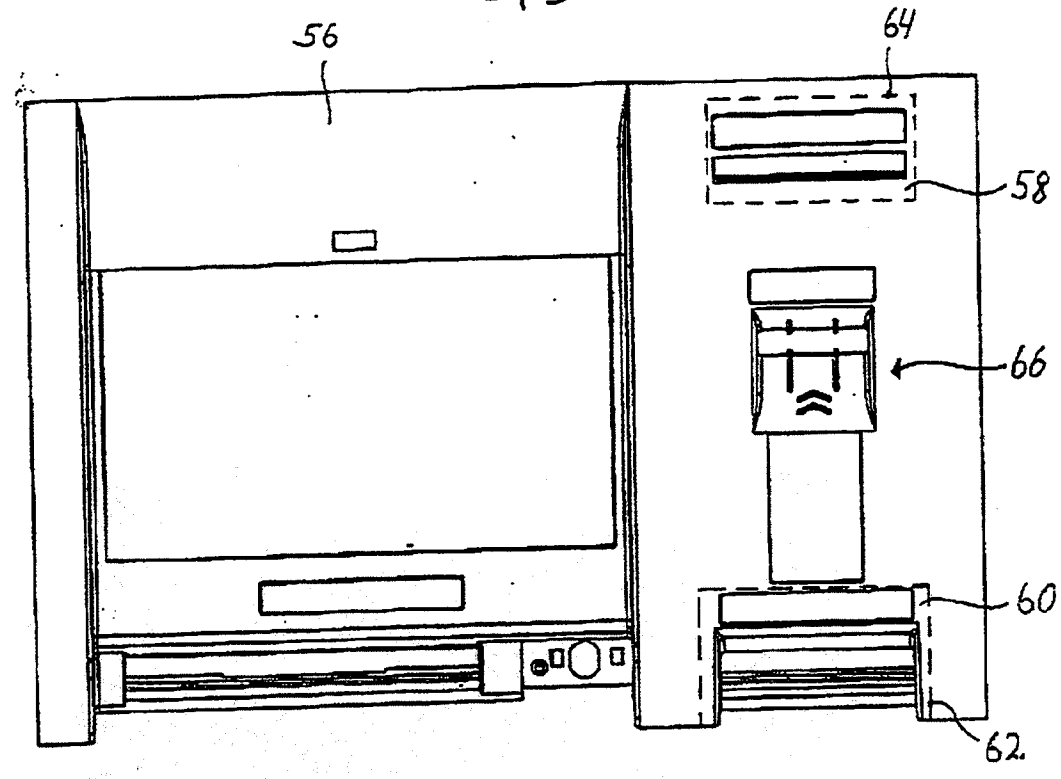

FIG. 4

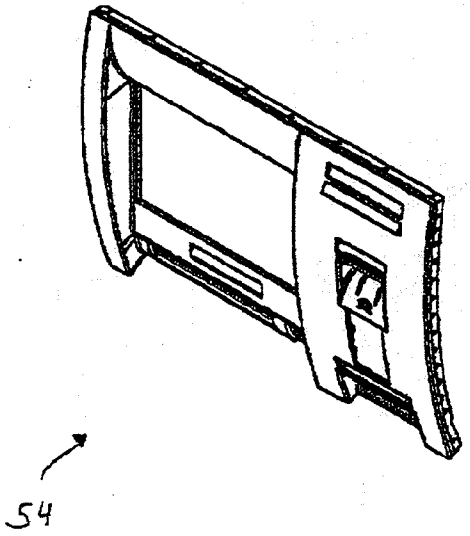

FIG. 5

Method and apparatus for producing formed portions from foamable plastics material

The present invention relates to a method for producing plastics formed portions, in which a gas pressure is built up in a form cavity of a forming mould. The form cavity is filled with a foamable plastics melt; after the filling has taken place the gas pressure in the form cavity is reduced so that the plastics melt foams, and in which after the plastics melt has solidified the formed portion is removed from the mould.

Furthermore, the invention relates to an apparatus for producing plastics formed portions from foamable plastics material, comprising a forming mould with form halves that enclose a form cavity, at least one feed opening through which the starting-material melt reaches the form cavity, and at least one venting opening.

In the case of the method mentioned above and termed a gas counter-pressure method, the plastics melt, which consists, for example, of a thermoplastic plastics material such as polycarbonate, is mixed with an expanding agent for foaming purposes. So that the surface of the formed portions is as smooth as possible, the form cavity must be filled completely with the plastics melt before the latter foams. Directly after having been poured in, the latter cools on the inner walls of the form cavity in the non-foamed state and thus obtains a smooth surface. After the gas pressure in the form cavity has been lowered, the plastics melt foams, with the reduction in volume that occurs upon cooling being compensated for and with a porous core forming below the surface of the formed portion.

In known gas counter-pressure methods operations are carried out with sealed moulds in order, whilst filling the form cavity, to maintain a gas pressure that prevents the plastics melt from foaming. The internal form pressure in the case of the gas counter-pressure method typically lies in the order of magnitude of 60-150 bar and is dependent upon the configuration of the formed portion and the plastics material used. For the purposes of comparison, it may be mentioned in this connection that in the case of conventional injection-moulding, operations are carried out at still much higher pressures (up to 1000 bar).

The disadvantage of the method used in the prior art is that the joint lines form to a great extent behind openings. When manufacturing operator panels of automatic cash dispensers for example, for the differently configured operator panels forming moulds are put together out of interchangeable inserts. It has been found that the edges of the interchangeable inserts stand out as burrs on the formed portion. This necessitates elaborate and thus expensive after-treatment of the surfaces of the formed portions.

Preferred embodiments of the present invention advantageously provide a method for producing formed portions from a foamable plastics melt, in which method a smooth and tight outer surface of the formed portions results even when interchangeable inserts are used. Furthermore, an apparatus for carrying out the method is also provided.

According to one aspect of the present invention there is provided a method for producing plastics formed portions , in which a gas pressure is generated in a

form cavity of a forming mould,

wherein the form cavity is filled with a foamable plastics melt;

after the filling has taken place, the gas pressure in the form cavity is reduced so that the plastics melt foams,

and after the plastics melt has cooled, the formed portion is removed from the mould,

wherein the gas pressure in the form cavity is kept at least approximately constant during the filling of the form cavity and a first cooling phase.

According to a second aspect of the present invention there is provided an apparatus for producing plastics formed portions from a foamable plastics melt, comprising a forming mould with form halves that enclose a form cavity,

at least one feed opening through which the plastics melt reaches the form cavity,

and at least one venting opening,

wherein a gas-supply line connects the form cavity to a device for regulating the gas pressure in the form cavity, which device regulates the gas pressure during the filling of the form cavity and a first cooling phase to keep it at an at least approximately constant value.

The object is achieved by means of a method in accordance with claim 1 and an apparatus in accordance with claim 6.

When filling sealed moulds, gas pressures of up to 150 bar are formed in the form cavity, necessitating, for their part, the use of high injection pressures in order to press the plastics melt into the form cavity. It has been recognized that these high internal form pressures result in the formation of burrs at the edges of the interchangeable inserts.

In the case of the method in accordance with the invention, during the filling and the first cooling phase the gas pressure in the form cavity is maintained at a value at which the plastics melt does not foam just yet.

The gas counter-pressure method in accordance with the invention can be used, for example, in order to manufacture operator panels for automatic cash dispensers. In the case of this application, special demands are made on the formed portion. For example, high mechanical strength values must be attained in order to be able to protect the automatic cash dispenser from vandalism. In order to guarantee sufficient protection, wall thicknesses of over 6 mm are required. Such wall thicknesses can also be obtained with the conventional gas counter-pressure methods. However, a sufficiently smooth surface is only obtained by means of the method in accordance with the invention, because with this method very low injection pressures suffice and therefore no burrs are formed at the edges of the interchangeable inserts. By means of the invention elaborate re-working, in which the resultant burrs are removed by grinding, smoothing

over, fillers and so on, is avoided. As a result, the costs of production are lowered and the production times are shortened.

For the sake of completeness reference may be made to the fact that the pressure in the form cavity may by all means move within a range. In this connection, a lower limiting value for the pressure follows from the demand that foaming of the plastics melt must be avoided. Such a value can, for example, lie at approximately 10 bar. An upper limiting value follows, as already explained, from the demand that the formation of burrs is to be avoided. This is the case, for example, at a pressure of less than 14 bar.

A first embodiment of the method in accordance with the invention provides that gas, which during the filling escapes from the form cavity in an uncontrolled manner, be replenished in order to keep the gas pressure in the form cavity at least substantially constant. By means of this method a situation is avoided where the form cavity or the forming mould needs to be totally sealed. It has been found that, for example, a seal in the region of ejectors is very elaborate and that therefore the costs of production for forming moulds, which are used in the case of conventional gas counter-pressure methods, are very high. In the case of this further development the pressure in the form cavity is measured and so much gas is replenished that the pressure in the form cavity adheres to the desired pressure value.

In the case of a second embodiment of the method in accordance with the invention, during the filling gas is drawn off out of the form cavity in a controlled manner so that an at least substantially constant gas pressure results in the form cavity. In the case of

this embodiment, for example when the upper limiting value for the gas pressure in the form cavity is exceeded, valves of venting channels are opened for so long until there is a fall below the upper limiting value again. During the first cooling phase, the valves remain closed in order to keep the gas pressure constant. If the surface of the foamable plastics melt has cooled and solidified to a sufficient extent, these valves can be opened so that the form cavity is vented. This embodiment of the method in accordance with the invention can be used whenever the fixed forming mould has controllable valves. This embodiment of the invention therefore enables fixed forming moulds to be capable of being re-used by retrofitting or exchanging the valves.

It is advantageous to build up the gas pressure at the same time as the closure of the two form halves that delimit the form cavity. As a result of this further development, after the formed portion has been removed from the mould the forming mould is very quickly available for further casting.

The invention further covers an apparatus for producing formed portions that has the features that are specified in claim 6.

In the case of the apparatus in accordance with the invention it is possible to remove or re-supply compressed gas from or to the form cavity by way of the venting opening and the gas-supply line in order to regulate the gas pressure during the filling of the form and the first cooling phase to keep it at an at least substantially constant value. By means of the deviation of the actual gas pressure from a rated value, the device for regulating the gas pressure

determines the quantity of gas that is to removed from or supplied to the form cavity. The apparatus in accordance with the invention can, for example, operate according to the regulating methods that have been explained further above.

In the case of an embodiment of the apparatus that is particularly advantageous structurally, at least one venting opening is arranged at the parting plane between the form halves. It is possible for gas that is supplied to the form cavity to escape by means of the venting opening thus arranged.

For a better understanding of the present invention, and to show how the same maybe carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 shows a plan view of the apparatus in accordance with the invention;

Figure 2 shows a sectional view of the mould shown in Figure 1 along the line of intersection A in Figure 1;

Figure 3 shows a section of a detail of the mould from Figure 1;

Figure 4 shows an operator panel of an automatic cash dispenser; and

Figure 5 shows a perspective representation of the operator panel shown in Figure 4.

Figure 1 shows the plan view of a forming mould 10 in accordance with the invention having a right-hand form half 11 with which operator-panel elements of an

automatic cash dispenser are manufactured. The form of the operator-panel elements is determined by a shell 12 and a core 14 for a recess in the operator-panel element. The shell 12 is composed of an upper section 16, a central section 18, which borders the core 14, and a lower section 20.

In the centre of Figure 1 it is possible to identify a sprue 22 through which molten, thermoplastic plastics material is pressed into a form cavity (see Figure 2). The shell 12 is bordered by an aerating and venting channel 24 which, for its part, is surrounded by an O-ring groove 26.

It is possible to install the portion of the forming mould 10 that is shown in Figure 1 in an injection-moulding machine by means of a plate 28. The plate 28 is thereby used as a carrier plate with which the right-hand form half 11 is held in the injection-moulding machine. Furthermore, four guide rods 30 are shown that guarantee that the right-hand and a left-hand form half 11 and 32 respectively (see Figure 2) are guided so as to fit exactly.

Figure 2 shows the right-hand and left-hand form half 11 and 32 respectively of the forming mould 10 in a sectional view along the line of intersection A (see Figure 1). The right-hand and left-hand form half 11 and 32 surround a form cavity 34 which is filled with a plastics melt. The form cavity 34 is connected to the sprue 22 by way of a sprue channel 36 which is perpendicular to the drawing plane. The upper and the lower section 16 and 20 respectively of the shell 12 can be seen clearly. Above and below the form cavity 34 it is possible to see the cross sections of the aerating channel 24 and the O-ring groove 26 that

extend on an outside 38 of the right-hand form half 11 facing the left-hand form half 32. The form cavity 34 is connected to a device 39 for pressure control by way of the aerating and venting channel 24. The forming mould 10 is sealed outwardly at the parting plane with the aid of the O-ring groove 26. In this representation it can also be seen that no separate seal is effected in the region of an ejector 40 and the sprue channel 36. In this region, the seal of the forming mould 10 would be particularly elaborate. Compressed gas, which escapes in this region, in particular along the ejector 40, is replenished by way of the aerating channel 24. The gas pressure in the form cavity 34 can therefore be kept constant during the filling and the first cooling phase.

In this first cooling phase the molten plastics material solidifies on the inner walls of the form cavity 34 that are formed by sections 42 and 44 of the outside 38 of the right-hand form half 11 and also by sections 46 and 48 of an outside 50 of the left-hand form half 32. After the surface of the plastics material located in the form cavity 34 has solidified, the compressed gas is drawn off by way of the venting channel 24 so that the plastics material foams. After a second cooling phase, in which the remaining mass of the plastics material cools and solidifies, the right-hand and left-hand form half 11 and 32 are moved part and the formed portion is removed from the mould with the aid of the ejector 40. For this purpose, the ejector 40 is moved in the direction of an arrow 52.

Subsequently, the right-hand and left-hand form half 11 and 32 are closed again, with gas that generates a counter-pressure again being pumped by way of the aerating channel 24 in the direction of the parting

plane between the two form halves 11, 32. Afterwards, liquid plastics material can again be injected into the form cavity 34 by way of the sprue 22 and the sprue channel 36 in order to cast the next formed portion.

Figure 3 shows a section of a detail perpendicularly in relation to the parting plane in the region of the aerating channel 24. It can be seen that the outside 38 of the right-hand form half 11 and the outside 50 of the left-hand form half 32 do not touch in a section between the form cavity 34 and the aerating channel 24 and form a through-channel 53. Whilst the form cavity 34 is being filled with plastics material, the compressed gas can escape through this through-channel 53 in the direction of the venting channel 24. On the other hand, before the form cavity 34 is filled it is possible for compressed gas to be pumped into the form cavity 34 by way of this through-channel 53.

Figures 4 and 5 show an operator panel 54 of an automatic cash dispenser which can be manufactured with the aid of the apparatus 10 previously described. The operator panel 54 is composed of three operator panel-regions 56, 58 and 60. In order to produce such an operator panel 54, a forming mould is composed of, for example, three interchangeable inserts. In this connection, one interchangeable insert is used for each operator-panel region 56, 58, 60. The course of the edges of the interchangeable inserts is indicated by means of lines 62 and 64. It can be seen clearly, in particular in Figure 5, that the surface of the operator panel 54 is uniformly smooth. Burrs have not formed at the edges of the interchangeable inserts.

It is not therefore possible to identify the interchangeable inserts on the visible surface of the

operator panel. For an operator panel without an insert shaft 66, for example for a credit card, another interchangeable insert for the operator-panel region 56 is simply used in the case of the forming mould for the operator panel 54. By means of the invention it is therefore possible to use the same forming moulds for differently configured operator panels.

Reference may again be made to the fact that as a result of the method in accordance with the invention, or the apparatus which operates according to this method, no after-treatment of the surface is required. This means that the operator panels can be processed further immediately after manufacture.

The invention thus makes an apparatus or a method available with which the gas counter-pressure method can be used, for example, even in the case of forming moulds that contain interchangeable inserts.

List of reference numerals

10	Forming mould
11	Form half
12	Shell
14	Core
16	Upper section of the shell
18	Central section
20	Lower section of the shell
22	Sprue
24	Aerating and venting channel
26	O-ring groove
28	Carrier plate
30	Guide rod
32	Form half
34	Form cavity
36	Sprue channel
38	Outside of the form half
39	Device for pressure regulation
40	Ejector
42, 44, 46, 48	Sections of the outsides of the form halves
50	Outside of the form half
52	Arrow
53	Through-channel
54	Operator panel
56, 58, 60	Operator-panel elements
62, 64	Boundary lines
66	Shaft

CLAIMS

1. A method for producing plastics formed portions , in which a gas pressure is generated in a form cavity of a forming mould,

wherein the form cavity is filled with a foamable plastics melt;

after the filling has taken place, the gas pressure in the form cavity is reduced so that the plastics melt foams,

and after the plastics melt has cooled, the formed portion is removed from the mould,

wherein the gas pressure in the form cavity is kept at least approximately constant during the filling of the form cavity and a first cooling phase.

2. Method according to claim 1, wherein during the filling, gas that escapes from the form cavity in an uncontrolled manner is replenished in order to keep the gas pressure in the form cavity at least approximately constant.

3. Method according to claim 1, wherein during the filling, gas is drawn off out from the form cavity in a controlled manner in order to keep the gas pressure in the form cavity at least approximately constant.

4. Method according to any one of the preceding claims, wherein the gas pressure is built up upon closure of form halves of the forming mould that

serve to delimit the form cavity.

5. Method according to one of the preceding claims, wherein the gas pressure is kept constant at a value in the region of approximately 10 to 14 bar.

6. Apparatus for producing plastics formed portions from a foamable plastics melt, comprising a forming mould with form halves that enclose a form cavity,

at least one feed opening through which the plastics melt reaches the form cavity,

and at least one venting opening,

wherein a gas-supply line connects the form cavity to a device for regulating the gas pressure in the form cavity, which device regulates the gas pressure during the filling of the form cavity and a first cooling phase to keep it at an at least approximately constant value.

7. Apparatus according to claim 6, wherein arranged at the parting plane between the form halves there is at least one venting opening through which gas supplied to the form cavity can escape.

8. Injection-moulded portion, in particular an operator panel for an automatic cash dispenser, which is produced with the aid of the method in accordance with any one of claims 1 to 5 by means of an apparatus according to claim 6 or 7.

9. An apparatus substantially as herein described with reference to, and as illustrated in, the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB 0101870.4 **Examiner:** Damien J Huxley
Claims searched: 1 to 9 **Date of search:** 12 June 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B5A: AD20, AD28, AD29, AD33, ANA, ANC, AT14B, AT14P, AT14U

Int Cl (Ed.7): B29C: 33/00, 33/10, 33/40, 45/00, 45/03, 45/34, 45/40, 45/43, 45/57

Other: ONLINE: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0914919 A1	(ASAHI KASEI....) see the figures, lines 4 to 9 & 48 to 51 of page 5 and lines 41 to 43 of page 7 in particular.	1, 6, 7
X	JP 8318542 A	(IDEMITSU.....) see the WPI Abstract Accession Number 1997-072519.	1, 6, 7
X	JP 3051110 A	(SAKAE RIKEN.....) see the figures and WPI Abstract Accession Number 1991-107449.	1, 6, 7
X	CA 1116364 A	(UNION CARBIDE) see the figures and lines 4 to 25 of page 9 in particular.	1, 6, 7
X	US 4855094	(HENDRY) see the figures and line 42 of column1 to line 32 of column 2 in particular.	1, 6, 7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.